Pulper device for the recovery of paper production waste, plant comprising said device and associated method for recovery of the waste

Description

Technical field

The present invention relates to a device for recovery of paper production waste in paper mills for the continuous production of paper webs, in particular but not exclusively of so-called "tissue" paper. More particularly, the invention relates to a pulper to be combined with a yankee drier in a continuous paper production machine, for the recovery and recycling of processing waste from the drier itself.

The invention also relates to a method for recovery and recycling of the production waste.

State of the art

In the production of paper, and in particular in the production of tissue paper, typically used as toilet paper, multipurpose drying paper and for other uses, a slurry of cellulose fibers and water is distributed from a head box onto a forming wire or onto a felt for forming a web. By means of successive passes, during which the water content in the slurry is gradually reduced, the web is conveyed to a section of the production line where it is more or less dried. Various systems may be used for drying. One of the most widespread systems consists of a so-called yankee drier, i.e. a large-diameter cylinder which is heated internally and around which the wet web is conveyed. When in contact with the cylinder, the web dries and is separated from the cylinder by a doctor blade which also performs crêping of the paper.

Examples of plants for the production of paper of this type are described in US-A-4,448,638, US-A-5,514,523, US-A-6,379,496 and in other patents cited therein.

During the continuous production of the paper web, breakages of the web with consequent waste production may occur. Moreover, the edges of the web are cut with the formation of trimmings since they have

irregularities which would be unacceptable in the finished product. This waste and these trimmings must be recovered and recycled.

At present, the waste which is produced underneath the yankee drier or other equivalent drying system is recovered manually and conveyed away for recycling by means of operations which are very labor-intensive. In addition to the cost which this represents, the presence of production waste around the machines constitutes a serious danger, since the cellulose fibers are highly inflammable.

Objects and summary of the invention

According to a first aspect, an object of the present invention is to provide a device which avoids the abovementioned drawbacks and is particularly suitable for the recovery of waste, trimmings or other paper scrap, especially that which is produced around the yankee drier.

These and further objects and advantages, which will become clear to those skilled in the art from reading of the text which follows, are obtained essentially with a pulper device for waste paper material, characterized in that it comprises: a container for collecting said waste, having an inlet opening for said waste; at least one pressurized water nozzle which produces a jet of water which intercepts the waste which falls into said container; and a first pump which removes the water and the waste from said container.

A device thus designed may be arranged below the yankee drier or other equivalent assembly in the paper production line, for collecting the waste, scrap and paper trimmings and recycling them automatically, without the need for storing them and transporting them manually away from the working zone. The jet produced by the water nozzle under pressure destroys at least partially the structure of the waste paper material, separating the fibers from each other as the first stage in the recovery process. The cellulose fibers may then be reintroduced into the production cycle, for example directly or indirectly into the head box which produces the layer of slurry for formation of the paper web.

According to a first practical embodiment of the invention, in order

to obtain effective demolition of the fiber structures forming the scrap or waste paper material, a first series of pressurized water nozzles and a second series of pressurized water nozzles are envisaged. Moreover, the nozzles are oriented so that the jets produced by the nozzles of the first series and the jets of the nozzles produced by the second series have trajectories which intersect in a zone where the waste or scrap falls. In this way, the scrap is struck by jets oriented in the incident directions, said jets exerting an efficient cutting, pulling and/or breaking action on the fiber structure. This facilitates the subsequent reintroduction, into the cycle, of the fibers at least partially individualized, i.e. separated from each other.

The nozzles may have trajectories with inclinations which are different from each other. Moreover, advantageously, it is possible to envisage that two inclined surfaces for guiding the jets produced by the nozzles may be associated with the first series and the second series of nozzles. The surfaces, which are for example flat surfaces, may be varyingly inclined, but are preferably inclined approximately with the same orientation of the axis of the jets produced by the nozzles. Said surfaces terminate in edges which delimit a passage for conveying the water and the refuse paper material toward the bottom of the container.

According to an advantageous embodiment of the invention, the container has an elongated longitudinal extension such that the inlet opening has an extension approximately equivalent to the axial extension of the yankee drier, for collecting the refuse, waste or other scrap along the whole of the front of the paper web being formed. In this case, parallel to the elongated upper opening of the container, the first and second series of nozzles extend.

In order to obtain improved separation of the fibers of the scrap paper material, according to an advantageous embodiment of the present invention it is envisaged that the pump is a so-called chopper pump. "Chopper pump" is generally understood as meaning a pump equipped with parts which are able to cut, break, tear or fragment parts or solid bodies contained in the liquid flow sucked by the pump. These pumps are

known per se. They usually consist of centrifugal pumps, the rotor of which is integral with cutting members. Examples of chopper pumps are described in US-A-4,402,648, US-A-4,640,666, US-A-4,519,904, US-A-4,778,336.

In order to permit better use of the water in the plant and in order to facilitate circulation of the mixture of water and fibers obtained by the destruction of the scrap or waste paper material, according to an advantageous embodiment of the invention a recirculation duct is envisaged between the chopper pump, or other equivalent pumping means, and the container. By means of the recirculation duct, a part of the flow sucked in by the pump is recirculated into said container in a direction such that as to favor suction of the refuse by the pump itself. For this purpose, the outlet of the recirculation duct is situated in a position approximately opposite the inlet mouth of the pump suction duct. Basically, if the container has an elongated extension, the outlet of said recirculation duct and the intake opening of said pump are arranged approximately at the ends of the elongated longitudinal extension of said container.

Still with the aim of favoring the outflow of refuse paper material from the container and the suction thereof by the chopper pump, according to an advantageous embodiment of the invention, the bottom of the container is inclined from the top downward and from the outlet of the recirculation duct toward the intake opening of the pump.

In order to facilitate the entry of the scrap, waste or other residual paper material into the device, according to a preferred embodiment of the invention, the container is connected to a suction duct which sucks air from the inside of said container. In this way, multiple advantages are obtained.

Firstly, entry of the waste which is in the form of pieces of paper is facilitated. Moreover, the vacuum which is produced inside the container results in the formation of an air flow from the outside toward the inside of the container, which sucks into the container also the waste in the form of

dusts or fibers or cellulose particles suspended in the atmosphere. These dusts are formed in large quantities owing to the action of the doctor blade which separates the web from the yankee drier. Efficient removal thereof is a guarantee of improved hygienic/sanitary conditions inside the warehouse where the plant is situated, in addition to greater safety against fire hazards. Thirdly, the fibers which are sucked inside the container owing to the vacuum are at least partly intercepted by the pressurized water jets and then automatically introduced into a water flow with the possibility of being recycled together with the fibers of the larger size structures which form the main waste produced by the yankee drier. A combined filtering and fiber-recovery effect is thus obtained.

In order to obtain an optimized circulation of air inside the container, which does not interfere with correct operation of the pressurized water nozzles, according to an advantageous embodiment of the invention, the suction duct has suction openings arranged underneath at least one of said two inclined surfaces.

The air flow sucked from inside the container may convey water droplets in suspension form due to the atomization produced by the pressurized water nozzles, Moreover, despite elimination performed by the water jets, dusts or fibers may also be entrained in the air stream. In order to eliminate these solid or liquid suspensions, according to an advantageous embodiment of the invention, it is envisaged that the suction duct may be connected to a separator in order to separate the air from the solid and/or liquid particles entrained in the air flow. For this purpose, a cyclone separator or an equivalent may be used for example.

The water flow, containing the fiber or residual matter resulting from the collection of scrap or waste paper material, removed from the collection container, has a very low quantity of solid. It is in principle possible to introduce this flow of water and fibers directly into the paper production cycle, for example into the head box. However, this could lead to an excessive water content in the cellulose slurry, i.e. to a cellulose content which is too low.

In order to overcome this possible drawback, according to an advantageous embodiment of the invention, a thickening station is provided to which, at least partly, the mixture of water and waste paper material sucked by means of the pump from the container is conveyed. In the thickening station the solid content of the mixture is increased, eliminating therefrom a part of the water content. The water eliminated is used, however, in the production cycle, for example for supplying the water nozzles.

Thickening stations are known per se and used in paper production plants. Examples of thickening stations are described in US-A-5,021,151, US-A-5,186,791, US-A-4,501,040, US-A-4,686,005 and US-A-4,722,793.

Further advantageous features and embodiments of the device according to the invention are indicated in the accompanying dependent claims.

According to a further aspect, an object of the present invention is to provide a method for recycling paper scrap, waste or trimmings, in particular formed around the yankee drier.

This and further objects and advantages, which will be clear to those skilled in the art from reading of the text which follows, are essentially obtained by means of a method for recovering and recycling waste paper material supplied from a paper production line, characterized in that said waste is subjected to a pulping action by means of at least one or more pressurized water nozzles so as to produce a mixture of water and waste paper material and in that said mixture is recycled. Advantageously, according to a possible embodiment of the method according to the present invention, the waste is reduced to pulp, not only by the action of said one or more pressurized water nozzles, but also by suction of a water flow containing said waste using a chopper pump.

Further advantageous features and embodiments of the method according to the invention are set forth in the accompanying dependent claims.

Brief description of the drawings

The invention will be better understood with reference to the description and the attached drawing, which shows a practical non-limiting embodiment of the invention. More particularly, in the drawings:

Fig. 1 shows a schematic side view of the terminal part of a paper production line in which in particular the yankee drier and the position of the pulper device according to the present invention are visible;

Fig. 2 shows a front view, along II-II, of Fig. 1 of the pulper device;

Figs 3 to 5 show two views and a cross section along the lines III-III, IV-IV and V-V of Fig. 2; and

Fig. 6 shows a diagram of the plant for recycling the waste processed by the pulper.

Detailed description of the preferred embodiment of the invention

Fig. 1 illustrates schematically the terminal part of the line for the production of a web or strip of paper, in particular tissue paper. 1 denotes the last wire or the last felt for conveying the partially dried layer of slurry formed in a manner known per se. The felt 1 is tangential to a yankee drier 3 so as to transfer the moist web from the external surface of the felt to the external cylindrical surface of the yankee drier 3 which is heated internally. The yankee drier 3 is embraced by the web over a wide contact arc, between the zone of tangential contact with the felt 1 and a doctor or separator blade 5. In a manner known per se the web V, which is dried owing to the heat exchange with the yankee drier 3, is separated from the cylinder and wound so as to form a reel B intended for further processing.

Below the yankee drier 3, and in particular in the zone where the doctor blade 5 is arranged, there is a device 7 for collection and recovery of the waste or scrap paper material produced by the yankee drier 3. The device 7 is shown in isolation and in greater detail in Figs 2 to 5.

Said device comprises a container 9 in the form of a tank or the like, which is elongated in the direction parallel to the axis of the yankee drier 3. The container 9 is provided at the top with an upwardly directed inlet opening 11 for collecting the scrap or waste paper material produced by the yankee drier 3. A first series of nozzles 13 and a second series of

nozzles 15 for pressurized water are situated along the longitudinal edges of the opening 11. Essentially the two series of nozzles are formed by means of respective pressure ducts, along the axial extension of which the nozzles are distributed. The nozzles are oriented downward and toward the bottom of the container 9, with angles of inclination A and B relative to the horizontal which are different from each other. Parallel to the direction of the axis of the nozzles of the two series, and therefore substantially parallel to the axes of the two series of jets produced by the nozzles, two walls or surfaces 21, 23 extend, therefore being inclined downward with angles A and B relative to the horizontal. The two surfaces 21, 23 are formed, in the example shown, by two surfaces which extend from the respective series of nozzles 13 or 15 toward the inside of the container, terminating in edges 21A and 23A, respectively. A passage for conveying the water and the refuse paper material toward the bottom of the container 9 is defined between the two edges 21A, 23A.

The arrangement is such that the waste or scrap paper material which falls or is sucked inside the container 9 intercepts the two series of pressurized-air jets supplied by the two series of nozzles 13, 15. The high-speed water supplied by the nozzles exerts a pulping action on the intercepted paper material. The incidence, at different angles, of the two series of jets has a cutting effect on the paper material which thus undergoes a first substantial operation involving destruction of the fibrous structure.

The paper material and the water supplied by the nozzles of the two series 13, 15 are collected on the bottom 9A of the container 9 which is formed inclined downward from one end to the other of the container 9 in the direction of longitudinal extension thereof, i.e. parallel to the direction of alignment of the nozzles 13, 15 of the two series.

In the lowermost zone of the bottom 9A of the container 9, an intake duct 25 of a pump 27 is situated. The latter is a so-called chopper pump, i.e. a pump comprising means able to break up and fragment any solid particles which are suspended in the water flow sucked in through

the intake duct. Typically the chopper pump 27 is a pump of the centrifugal type. The refuse paper material which is sucked in by the pump 27 is thus further pulverized.

As shown in particular in the hydraulic flow diagram shown in Fig. 6, a delivery duct 29 which has a branched recirculation duct 29A extends from the chopper pump 27. The branched duct 29A emerges inside the container 9, at a greater height than the inlet mouth of the intake duct 25 and at the opposite end of the container 9. With this arrangement, a part of the delivery of the chopper pump 27 is recirculated directly into the container 9. The flow which is produced is oriented parallel to the longitudinal direction of the container 9 and therefore facilitates the outflow of the residual paper material along the bottom 9A of the container 9 which is in any case inclined downward from the outlet of the branched duct 29A toward the inlet mouth of the intake duct 25 of the pump 27. A valve 30 for regulating the recirculation flow is arranged on the branched duct 29A.

As can be seen from the diagram in Fig. 6, the main duct 29 extends as far as a second pump 31 which, by means of a delivery duct 33, conveys the flow of water and refuse paper material extracted from the container 9 toward a thickening station generically denoted by 35. Here the density of the mixture of water and cellulose fibers obtained from the destruction of the scrap or waste paper material is increased. The substantially purified water which is extracted from the thickening station 35 is discharged by means of a duct 37 into a tank 39 from where it is subsequently recycled. From this tank, water is for example removed (by means of a pump 40) in order to supply the nozzles of the series of nozzles 13, 15, as well as for other utilities, for example for the said thickening station 35, by means of a pump 42 and a duct 44. From an overflow 46 any excess water is discharged from the tank 39 and conveyed away for further purification.

The thickened mixture, i.e. with a richer solid content (having a solid content for example of about 4% by weight) is discharged from the

thickening station 35 into a second tank 41 and from here recycled by means of conveying to the inflow chamber (not shown) which is supplied with the slurry for production of the web V.

The interior of the container 9 is kept under a vacuum by means of a suction duct 51, the inlet 51A of which is located below the inclined surface 23A, between the latter and the external wall of the container 9. Here a closed volume is defined by means of a further separating baffle 53 which has suction openings 55. Air is sucked from the container 9 toward the suction duct 51 through the openings 55. Any fibrous dusts and/or small droplets of atomized water are also entrained in the air flow.

The suction duct 51 leads into a separator 53, which in the example illustrated is shown as a cyclone separator. Here the liquid and/or solid particles suspended in the air flow are separated and recovered, while the air flow is discharged externally. 55 denotes the suction fan which draws the air through the duct 51.

It is understood that the drawing shows only one practical embodiment of the invention, the forms and arrangements of which may vary without thereby departing from the scope of the idea forming the basis of the invention. The presence of any reference numbers in the accompanying claims has solely the purpose of facilitating the reading thereof in the light of the above description and the accompanying drawings and does not limit in any way the scope of protection.